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One-step reconstruction of the severely resorbed mandible with onlay bone grafts and endosteal implants

A 5-year follow-up

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Abstract. The severely resorbed mandibles (Cawood and Howell class VI) of 31 female patients were reconstructed with a corticocancellous bone graft with ITI implants in a one-step procedure. After 12–16 weeks, a combined mucosally and implant-supported overdenture was made by an experienced prosthodontist. After 3, 6, 12, 24, and 60 months, orthopantomograms were made, and the height of the bone was measured mesial and distal of each implant. The overall bone resorption rate was almost 50%, but it varied around each implant. Eight of 78 implants were lost. Bone resorption occurred in an unpredictable way. The technique used can no longer be recommended.

Key words: endosteal; bone grafts; preprosthetic surgery.

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Lack of denture retention because of an inadequate denture-baring area may cause both functional and psychologic problems. Implant retained overdentures have proven to be a major step forward in restoring oral function in edentulous patients. In most cases, patients appeared to have gained self-assurance, and they felt dentally and socially rehabilitated[17,18].

In severely resorbed mandibles (Cawood & Howell[4], class VI), the remaining bone height is often insufficient to insert endosteal implants of adequate length. There are reports of several treatment strategies whereby first the mandible is augmented and then implants are placed in a second-stage procedure[5,8,9].

The concept of reconstructing the mandible in a one-step procedure was introduced by Brånemark & Breine[1,3]. They proposed a one-step onlay procedure using tibia bone in which threaded implants had been placed 3–6 months earlier. They suggested that early loading of the implants would decrease the resorption rate. However, there are no earlier studies with statistical analysis to substantiate this claim.

This study presents the results of a group of patients with severely resorbed mandibles (Cawood & Howell[4], class VI) treated in a one-step procedure using an autogenous iliac crest onlay bone graft with simultaneous placement of endosteal ITI threaded implants. Special attention was paid to the fate of the bone grafts.

Material and methods

Thirty-one female patients with severely resorbed mandibles (Cawood & Howell[4], class VI) were included in this study. The height of the mandible as measured in the symphysis from a cephalometric radiograph was 8 mm or less. The patients were aged 42–61 years (average, 51 years). A corticocancellous bone graft taken from the iliac crest was shaped to the desired format. The thickness of the graft was approximately 12 mm. Two or three one-stage, 10-mm ITI full or hollow screw implants were inserted and countersunk. The bone grafts with the implants were adapted to the recipient site and fixed with two circummandibular wires.

Seventy-eight implants were placed (16 grafts with three and 15 grafts with two implants). The area distal to the mental nerve was augmented with hydroxyapatite granules, held together by a Vicryl tube[7] (Fig. 1).

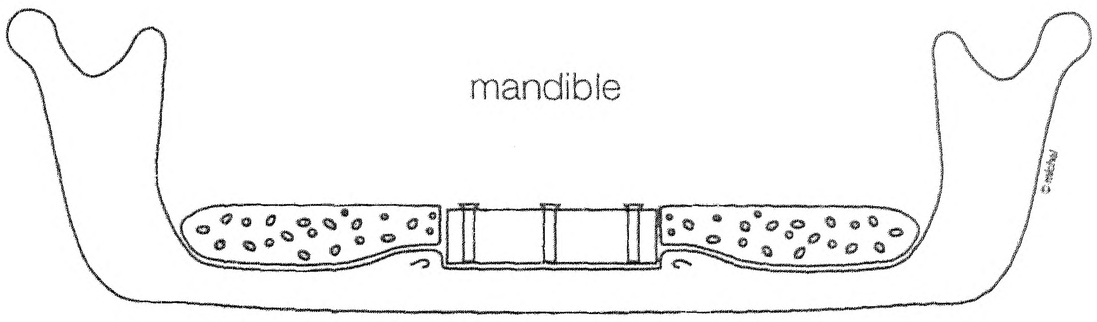

Fig. 1. Pattern by which patients were treated.

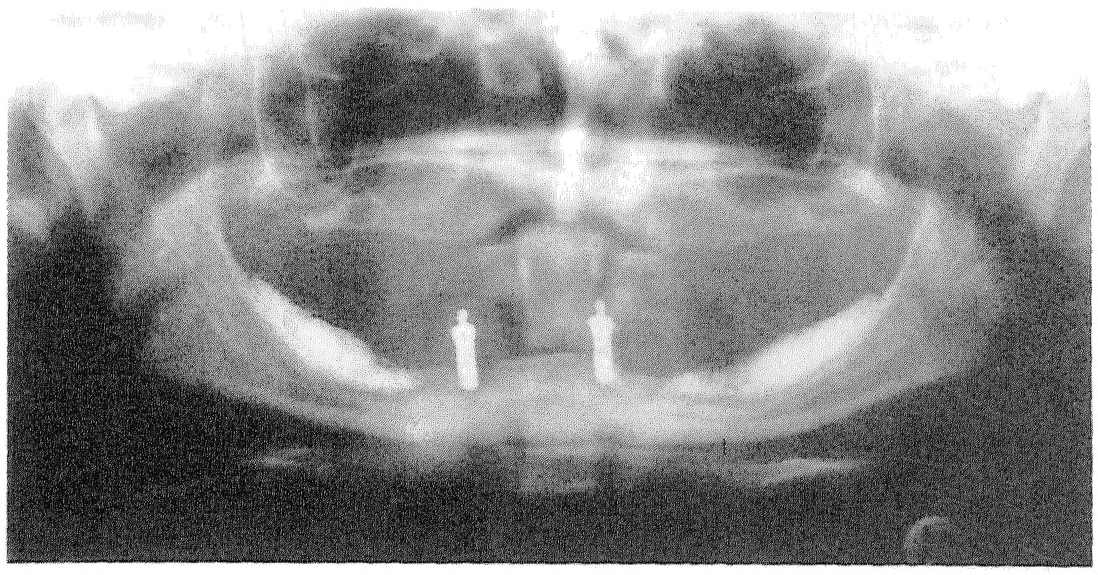

Fig. 2. Orthopantomogram showing more than 50% bone resorption around implants after 60 months.

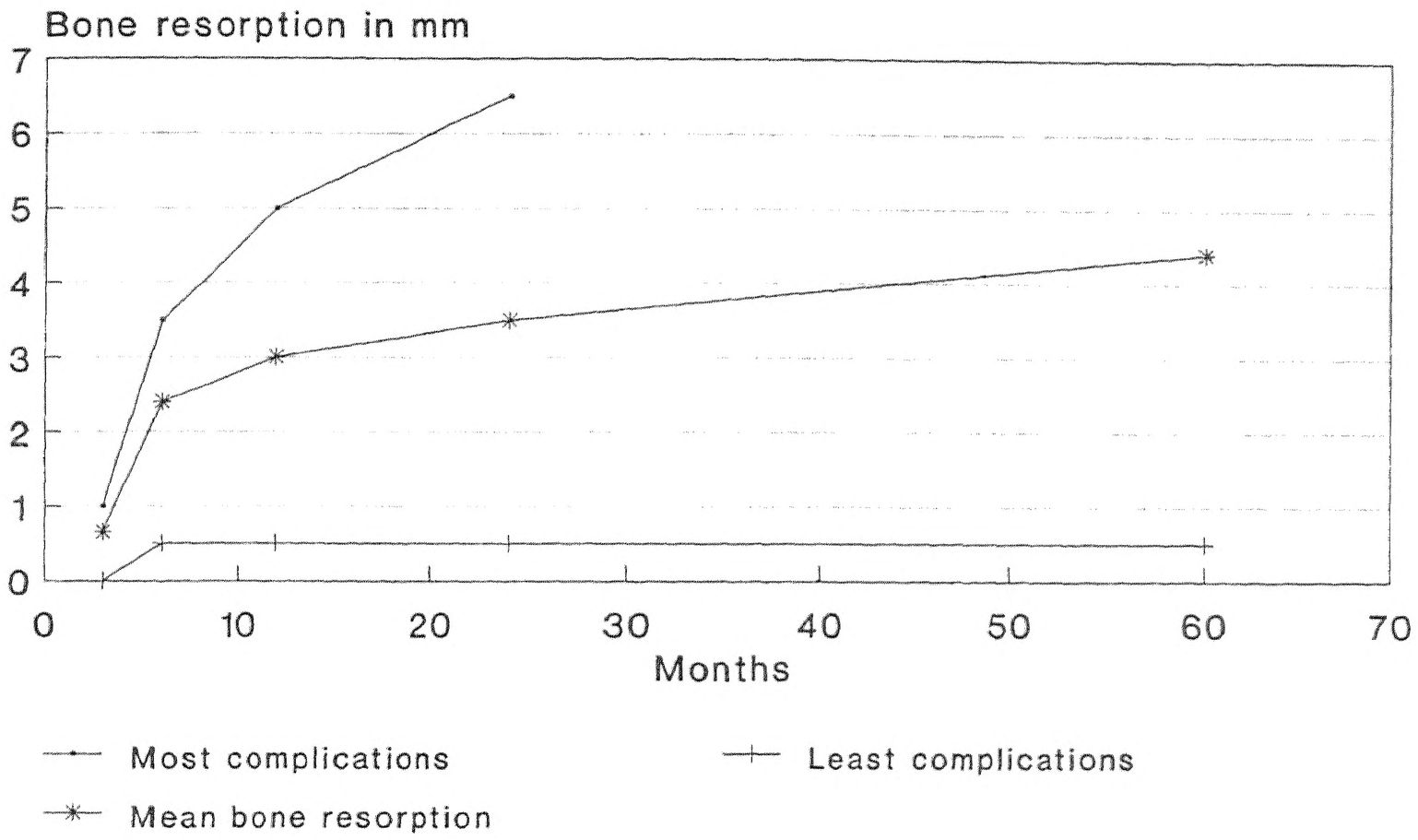

Fig. 3. Development of bone resorption over time.

After 10 weeks, the implants were exposed by a buttonhole incision. An experienced prosthodontist constructed the overdenture and the superstructure on the implants. The retentive system was either a dolderbar or two ball attachments. Functional loading was started after 12–16 weeks.

After 3, 6, 12, 24, and 60 months, orthopantomograms were made, and the height of the bone was measured left and right of each implant. The vertical bone height was related to the distance between the threads of the implants. Because the interthread distance of the implants was accurately known (1.28 mm), the bone resorption could be calculated.

Results

The mean bone resorption amounted to almost 50% after 5 years. Since there were four patients with minimal (less than 2 mm) resorption, this implies that there were several patients who had considerably more than 50% bone resorption (Fig. 2).

Three patients lost their implants and their superstructure. Two patients lost one implant, resulting in a total loss of eight implants. In some cases, considerable resorption around the implants was observed, while the nonloaded segments showed less resorption. In the same patient, resorption could occur around one implant while the bone around the other implant maintained well.

Table 1 shows the amount of vertical bone loss in millimeters. There was rapid resorption averaging 3.0 mm during the first 12 months. After the second year, the resorption rate showed a mean value of 3.5 mm, and 4.4 mm after 5 years. The first implant was lost (removed) after 4 months because of incurable peri-implantitis. The last implant was removed after 50 months.

Fig. 3 shows the development of the bone resorption around the implants that presented the most complications and eventually were lost or removed. It also shows the mean development of the bone resorption around the remaining implants and the implant with the least bone resorption.

The overall conclusion was that the resorption occurred unpredictably.

Discussion

In spite of the functional and early loading of the implants, the resorption appeared to be substantial and grossly corresponded with the resorption of subperiosteally augmented mandibles without implants[6,14,15].

A Cawood class VI mandible is very thin and often sclerotic, and consists of poorly vascularized bone. For this reason, we did not use the implants to secure the transplants on the mandible; instead, we used two circummandibular wires. These wires could be a drawback. Rigid fixation of a bone graft is essential for small blood vessels to grow into the graft. Circummandibular wires may not ensure rigid fixation; therefore, the new vessels may be disrupted and the bone graft fail. Fixed implant bridges combined with onlay augmentation, fixed to the recipient site by screw-type implants, may have caused less resorption[11–13,16].

Table 1. Mean vertical bone loss in millimeters

Implant	1	2	3	Overall mean	Lost implants
3 months	0.56	0.6	0.8	0.66	1.39
6 months	1.85	2.75	2.58	2.3	3
12 months	3.13	2.9	3.11	3.0	4.16
24 months	3.65	3.11	3.65	3.5	6
60 months	4.95	4.26	3.93	4.4	

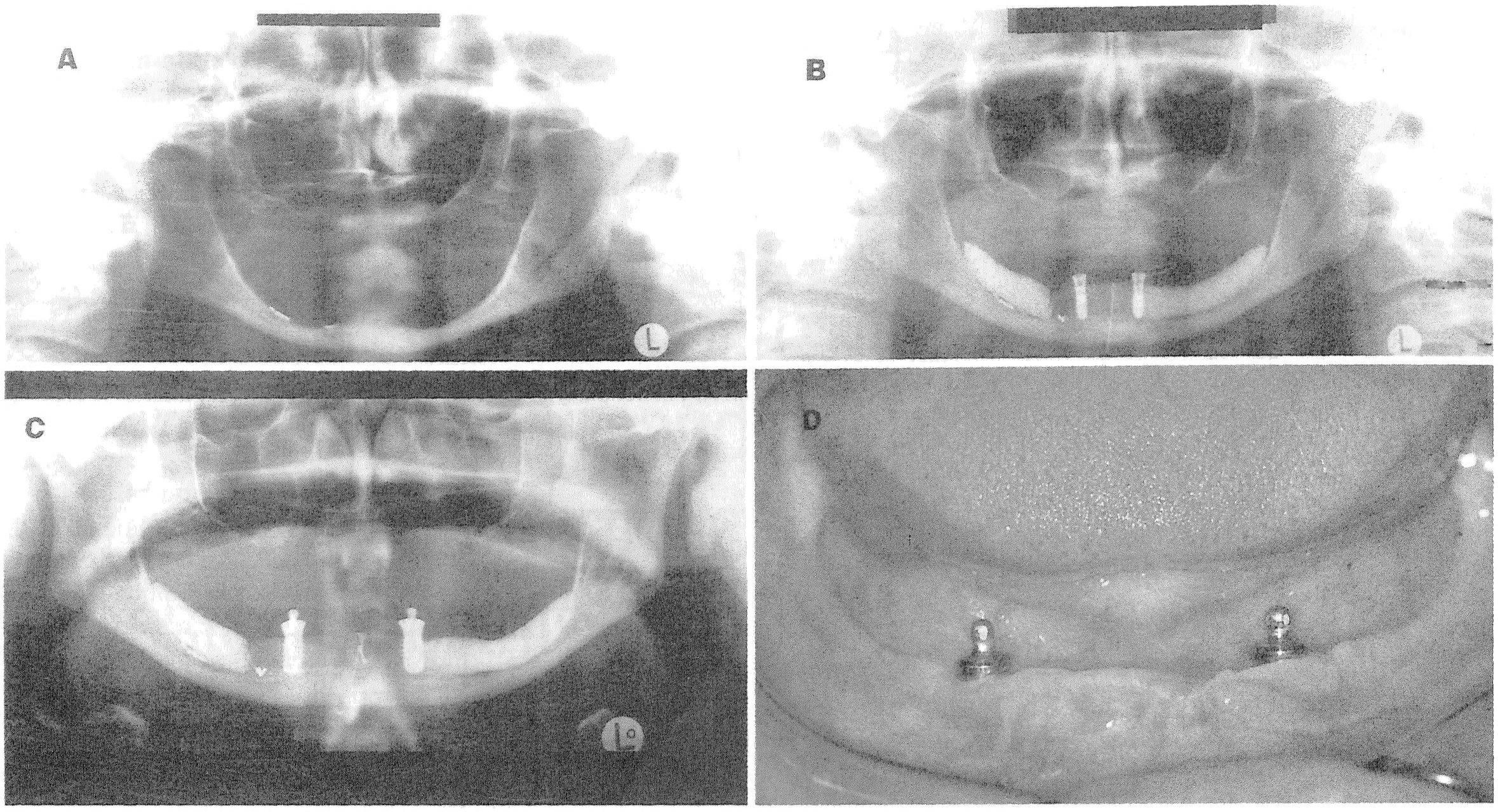

Fig. 4. A) Class VI mandible before reconstruction; B) same patient 3 months after treatment; C) same patient 16 months after treatment; D) same patient 60 months after treatment.

The fact that less resorption was noted when tibial[3] and calvarial bone[10] was used probably reflects the fact that both donor sites represent denser and more cortical bone.

It seems unlikely that unfavorable denture loading influenced these results. All the dentures were made by an experienced prosthodontist who paid appropriate attention to balanced occlusion and articulation and passive fit of the superstructure (19). The dentures were checked at regular intervals to eliminate any occlusal disturbance that could cause unfavorable loading. The dentures made were all mucosally and implant supported.

Four patients showed minimal resorption (Fig. 4A–D). The gonial index of these patients was determined, because it is claimed that a high-risk-of-resorption patient group may be identified by this index[2]. However, these four patients did not differ from the rest of the group. In our study, this variable did not appear to be of value in predicting a rapid resorption pattern.

This study seems to indicate that the present technique using subperiosteal bone grafts with simultaneous placement of endosteal implants and the subsequent fabrication of mucosally and implant-supported overdentures do not lead to satisfactory and predictable results.

Interposed bone grafting with secondary placement of implants, or onlay techniques using vascularized grafts may offer a better solution for patients with extremely resorbed mandibles.

The same technique as described above but modified by fixing the bone graft with screw implants to the recipient site may also achieve acceptable results. Further long-term follow-up studies of these techniques are necessary to gain more insight into this problem.

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